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RHYTHM DISTURBANCES WITH RISK OF HEART FAILURE IN NEWBORNS

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Based on the observation of 30.206 newborn infants (18.884 full term-, 10.443 preterm newborns, and 879 full term and premature infants hospitalized at cardiological departments) authors found the incidence of pathologic rhythm disturbances involving the risk of heart failure in full term newborns free from other disease to be 0.074 % and in preterm newborns without other disorder to be 0.211 %. The difference in its incidence between the two groups is statistically strongly significant ($p < 0.005$). The difference in the incidence of rhythm disturbances between newborn and premature infants in whom arrhythmia was associated with another disease did not reach the significance level (0.446 % and 0.626 % respectively). Among the infants with congenital heart disease requiring cardiologic treatment in newborn age (0-27 days) the incidence of rhythm disturbances was 4.1 %. The 58 patients with pathologic arrhythmia (24 full term-, and 34 preterm infants) were followed up until the age of 3 years. At that time pathologic arrhythmia was still present in 18 % of the patients (in 15 % of the full term- and 19 % of the premature newborns).

In the treatment of rhythm disorders of supraventricular origin digoxin and beta receptor blocking agents (Oxprenolol = Trasicor) were applied with good results. The intravenous administration of Verapamil is not recommended in newborns. For the treatment of ventricular arrhythmia Phenytoin appears to be the drug of choice.

Our knowledge of the characteristic features of impulse formation and impulse conduction /1, 5, 9, 12, 18/, and of their pathologic states /6, 10, 15/ in the neonates has significantly increased during the past decades. Transitory, benign functional disturbances of cardiac impulse formation and/or conduction are not infrequent in the first days of weeks of life /15, 18, 19/. Data are scarce, however, on the incidence and prognosis of dysrhythmias occurring in neonatal age (0-27 days) and endangering circulation - termed by us pathologic dysrhythmias.

Our present work was aimed at establishing the incidence of pathologic dysrhythmias in the following types of newborn population: a/ full term newborns

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from other disease, b/ preterm infants without other disease, c/ full term infants suffering from other disorder beside dysrhythmia d/ preterm infants suffering from other disorder beside dysrhythmia, e/ preterm infants with congenital heart disease (CHD). A 3-years follow-up of these patients made it possible to obtain information on the course and prognosis of these dysrhythmias.

MATERIAL AND METHOD

The preterm- and full term newborns included in the study were first observed between 01.01.1977. and 31.12.1983. The patients diagnosed as having dysrhythmia were followed-up for a 3 years period.

The group of full term- and preterm infants with dysrhythmia but free from other disorder consisted of the newborns cared for at the Department of Obstetrics at the Tétényi út Hospital and the preterm infants hospitalized at the Schöpf Mérei Ágost Hospital, Budapest. Patients treated at the Department of Paediatrics No.2 of Semmelweis University Medical School suffering beside arrhythmia also of some other disease formed the preterm- and full term newborn groups called by Jedeikin as "stressed infants" /11/. Inclusion of the patients into the different groups was made according to the aspects recommended by Jedeikin /11/.

Full term newborns suffering only of dysrhythmia
Uncomplicated pregnancy and delivery.
Gestational age: 36-42 weeks, birth werght higher than 2499 g.
No pathologic deviation beside dysrhythmia was observed at the Department of Obstetrics.
Neither CHD, nor cardiomyopathy (CMP) can be proven.
Preterm newborns suffering only of dysrhythmia
Uncomplicated delivery.
Gestational age less than 36 weeks, birth weight 2499 g or below. No pathologic deviation observed beside dysrhythmia while hospitalized at the Department of Preterm Infants.
Neither CHD, nor CMP can be proven.
Full term newborns suffering beside dysrhythmia also of some other disease ("stressed infants")
Gestational age: 36-42 weeks, birth weight higher than 2499 g.
Dysrhythmia associated with a proven disease.

Preterm newborns suffering beside dysrhythmia also in some other disease (stressed)
Gestational age less than 36 weeks, birth weight 2499 g or less.
Dysrhythmia associated with a proven disease.

For determining the incidence of pathologic dysrhythmias among infants with CHD requiring caardiologic treatment already in neonatal age we evaluated not the earlier mentioned 7-years period but the greater number of possibly more reliably observable patients treated at the Departments of Cardiology and Cardiac Surgery of the Department of Paediatrics No. 2, Semmelweis University Medical School between 01.01.1974. and 30.06,1986. (13.5 years).

Our concept of pathological rhythm disturbance

Heart rate is considered pathologic if at rest (sleep) it surpasses, or does not reach even on effort (crying) the 98 and 2 percentile values respectively, determined by Davignon /2/. In the case of ectopic rhythm heart rate should be evaluated considered the characteristic frequency range of the given pacemaker. For example: the 150/min heart rate of a 2 days old newborn corresponds the 95 percentile value which is not pathological, however if it is an ectopic rhythm of ventricular origin it should be evaluated as severe ventricular tachycardia.

Premature beats are considered pathological if they occur at a frequency greater than 1/min, or prove to be multifocal. Ventricular extrasystolia is considered pathologicaal if it belongs to group III-IV of Lown's grading. Patients with pathological extrasystolia were each time followed-up by Holter monitoring for establishing the possible development of tachy-arrhythmia.

Among the disturbances of impulse conduction grade III atrioventricular (AV) block was regarded as endangering circulation. Grade II AV-block was considered dangerous for circulation only if heart rate decreased below 50/min.

Prolongation of the corrected QT interval respresenting duration of ventricular repolarization was each time regarded pathological.

Patients suffering from pathologic arrhythmia were followed-up until the age of 3 years (at the age of 1.3 and 6 months, and 1 and 3 years). Each time a 12 lead ECG recording and a 10 minutes recording with a speed of 10 mm/sec were performed, in some cases completed by a 24-hour ECG-monitoring.

RESULTS

Among the 16.193 full term newborns free from other disorder 0.074 % (12 patients) were found to have pathologic arrhythmia (Table I). The average birth weight of the 3 male and 9 female newborns was 3106 g (2700-4000). Congestive heart failure occurred in 5 patients. Emergency treatment became necessary in 6 cases. The control examination performed at the age of 3 years revealed arrhythmia only in one patient.

From the 7.568 preterm infants free from other disease 0.211 % (16 patients) proved to have pathologic rhythm disturbance (Table II). The average birth weight of the 3 male and 13 female newborns was 1926 g (1380-2400 g). Congestive heart failure occurred in 6 patients. Emergency intervention was required in 10 cases. At the end of the 3 years' follow-up period 3 children had proven dysrhythmia.

From the 2.691 "stressed infants" (suffering from other disease) 0.446 % (12 patients) had rhythm disturbance endangering circulation (Table III). 10 boys, 2 girls had average birth weight of 3.140 g (2600-3800 g). CHD could be proven in 4 of them. Congestive heart failure occurred in 8, acute treatment was necessary in all except one of them. 3 patients died from this group (2 due to CHD, 1 due to CMP). No rhythm disturbance was seen at these patients at the last control before death. At the final control at the age of 3 years 8 patients were examined, 3 of them had still rhythm disturbance and needed further observation.

TABLE I

Full-term newborns with pathologic dysrhythmia , free of other disease

	Name, sex birth weight		Diagnosis	CHF	Treatment	Dysrhythmia at control at 3 ys of age
1.	B.C. 2610 g	m	PSVT	-	-	-
2.	D.A. 3000 g	f	VES(Lown III)	-	Epanutin iv	VES(Lown I)
3.	G.J. 2650 g	f	SVT	+	Trasicor iv	-
4.	H.A. 3800 g	f	SinBC	-	-	-
5.	K.J. 2900 g	f	SVES 2nd degree AV-b	-	-	-
6.	K.C. 3780 g	f	PSVT	+	Digoxin iv	-
7.	M.A. 3400 g	m	wandering PM	-	-	-
8.	P.M. 3050 g	m	VTC	+	Epanutin iv	-
9.	R.K. 3100 g	f	SinBC SVES, VES	+	Atropin iv	-
10.	S.A. 3400 g	f	VTC	+	Epanutin iv	-
11.	S.E. 3400 g	f	SinBC 2nd Degree AV-b	-	-	-
12.	S.J. 3350 g	f	SVES	-	-	-

Abbreviations in all the tables:

PSVT = paroxysmal supraventricular tachycardia
AF = atrial fluttern
RDS = respiratory distress syndrome

Table I. cont.

SVES = supraventricular extrasystole
VES = ventricular extrasystole
VTC = ventricular tachycardia
SVT = supraventricular tachycardia
AV-b = atrioventricular block
CHF = congestive heart failure
CMP = cardiomyopathy
CHD = conganital heart disease
SinBC = sinus bradycardia

TABLE II

Preterm newborns with pathologic dysrhythmia free from other disease

	Name, sex birth weight		Diagnosis	CHF	Treatment	Dysrhythmia at control at 3 ys of age
1.	B.A. 1380 g	f	PSVT	+	Trasicor iv	-
2.	B.T. 2400 g	m	SVES + VES 2nd degree AV-b	+	Epanutin iv	-
3.	B.B. 2400 g	f	PSVT	+	Digoxin iv Trasicor iv	SVES
4.	D.L. 1900 g	f	SVES	-	-	-
5.	E.V. 1910 g	f	SVES	+	Trasicor iv	SVES
6.	F.K. 1450 g	f	SVT	+	Trasicor iv	-
7.	F.E. 2400 g	f	SVES + VES 2nd degree AV-b	+	Trasicor iv	-
8.	G.T. 1780 g	f	SVES	-	-	-
9.	J.M. 1900 g	f	SVES	-	-	-
10.	K.D. 2250 g	f	3rd degree AV-b	-	-	3 rd degree AV-b
11.	M.A. 2000 g	f	SVES	-	-	-
12.	N.N. 2140 g	f	SVT	-	Trasicor iv	-
13.	S.B. 2100 g	f	PSVT	-	Digoxin iv Trasicor iv Neo-Gilurytmal	-
14.	T.T. 1720 g	f	SVES	-	-	-
15.	F.G. 1410 g	m	SVT	-	Digoxin iv Neo-Gilurytmal	-
16.	V.A. 1680 g	m	SinBC 2nd degree AV-b	-	Atropin iv	-

TABLE III

Full-term newborns suffering beside dysrhythmia also of other disease

	Name, sex Birth weight		Diagnosis	CHF	Treatment	Dysrhythmia at control at 3 ys of age
1.	H.L. 3000g	f	PSVT Infection	+	Verpamil iv	SVES
2.	K.A. 2700 g	f	SVES Infection	-	Trasicor iv	-
3.	K.B. 3000 g	m	AF CMP	+	Digoxin iv	-
4.	M.N. 2870 g	m	AF Infection	+	Digoxin iv	-
5.	P.G. 2900 g	m	VES(Lown III) Infection	+	Epanutin iv	-
6.	P.M. 2800 g	m	SVT CHD[x]	+	Digoxin iv	Death at 4 m
7.	P.L. 3000 g	m	SVES CHD[xx]	+	Trasicor iv	Death at 2 m
8.	S.K. 3500 g	m	SinBC, 2nd degree AV-b Cerebral haemorrh.	-	Isuprel inf.	Death at 3 d
9.	S.K. 3600 g	f	VES, 3rd degree AV-b Infection	-	-	-
10.	S.G. 4000 g	m	3rd degree AV-b Infection	-	Isuprel inf. Pacemaker impl at 3 ys of age	3rd degree AV-b
11.	V.K. 3000 g	m	SVES CHD[xxx]	+	Digoxin iv	-
12.	W.F. 2900 g	m	SVT Infection	+	Digoxin iv	no control

x Cong.corrected transposition of the great arteries Ventricular septal defect, periph.pulm.sten., anomalies of the bronchi

xx Univentricular heart with common atrium. Cong.atresia of the biliary duct.

xxx Atrial septal defect. Supero-inferior ventricles.

TABLE IV

Preterm newborns suffering beside dysrhythmia also of other disease

	Name, sex Birth weight	Diagnosis	CHF	Treatment	Dysrhythmia at control at 3 ys of age
1.	B.Z. f 2100 g	PSVT Infection	+	Trasicor iv	-
2.	C.S. m 2490 g	VTC Infection	+	Epanutin iv	-
3.	D.J. f 1410 g	SVT Infection	+	Digoxin iv	-
4.	G.G. m 1810 g	Long QT, SVES, VES RDS	+	Trasicor iv	-
5.	G.C. m 1620 g	SVES Infection	+	Trasicor iv	-
6.	J.E. f 1900 g	3rd degree AV-b CHD (transposition of the great arteries)	+	Isuprel inf.	3rd degree AV-b
7.	S.V. m 1700 g	SinBC Infection	+	Atropin iv	-
8.	K.B. f 2250 g	PSVT Infection	+	Digoxin iv	-
9.	K.K. f 1800 g	WPW, PSVT CHD (VSD)	+	Trasicor iv	WPW without PSVT
10.	K.J. f 2250 g	VES(Lown III) CHD (Fallot)	-	Diphedan (phenytoin)	no control
11.	K.O. f 2250 g	VES(Lown III)	+	Epanutin iv	no control
12.	L.E. f 1700 g	PSVT Infection	+	Neo-Gilurytmal	-
13.	M.Z. m 1600 g	PSVT Morbus Ebstein	+	Digoxin iv	-
14.	P.B. m 1450 g	SVT Infection	+	Neo-Gilurytmal	-
15.	R.Z. m 2000 g	AF.Hypoplastic left heart	+	Trasicor iv	Death at 2 m
16.	V.I. m 1900 g	SVT Infection	+	Trasicor iv	-
17.	Z.A. m 1750 g	PSVT Infection	+	Neo-Gilurytmal	-
18.	W.E. f 2100 g	SVES CMP	-	-	SVES

From the 2.875 preterm infants suffering from some other disease pathologic rhythm disturbance occurred in 0.626 % (18 patients) (Table IV). The average birth weight of the 9 male and 9 female newborns was 1799 g (1410-2490 g). Structural cardiac disorders could be demonstrated in 6 of them, congestive heart failure developed in 16. Acute treatment had to be applied in all but one cases. Fifteen patients appeared for control examination at the age of 3 yeaars. In 3 of them arrhythmia was still present.

DISCUSSION

Our study has furnished data on the incidence and prognosis of pathological disturbances of impulse formation and/or conduction in full term and preterm infants. While numerous monographs and papers are concerned with the characteristic features of the different forms of arrhythmia e.g. supraventricular tachycardia (8, 16), atrial flutter/-fibrillation (3, 13). 3rd degree AV-block /14/, however studies are scarce aimed at the evaluation of the whole of the arrhythmias of the neonates on a larger population /15, 18/.

Our statement concerning rhe incidence of arrhythmias endangering circulation in the first four weeks of life was based on our observation of a population including 30.206 preterm and full-term newborns.

The group of neonates suffering from arrhythmia but free from other diseases derived from a population of 16.193 full-term and 7.568 preterm infants. The 2.691 full term and 2.875 preterm newborns suffering also from some other disorder treated at the hospital departments constituted the group of "stressed" full-term and preterm infants. We have evaluated also the data of 879 preterm and full-term newborns (654 of them with congenital heart disease) hospitalized at our Department of Cardiology.

The difference between the 0.074 % incidence of arrhythmia in the group of full term infants free from other disorder and

the 0.211 % incidence of arrhythmia in the similar group of preterm newborns is statistically strongly significant: $p < 0.005$. This fact indicates that we have to calculate with higher frequency of pathological rhythm disturbances in preterm than in full-term babies.

The difference in the incidence of arrhythmias between full-term and preterm newborns suffering also from other disease (stressed) was statistically not significant (0.446 % and 0.626 % respectively).

Among the 879 preterm and full-term infants hospitalized at our Departments of Cardiology and Cardiac Surgery we demonstrated pathologic arrhythmia in 163 (18.5 %). This indicates that among newborns requiring cardiologic treatment pathologic dysrhythmias may occur with a considerable frequency, in spite of the fact that the majority of arrhythmias in neonatal age have benign character /5, 9, 10, 17, 18/. From the 654 infants with CHD requiring cardiologic/cardiosurgical treatment in neonatal age 4.1 % (27 newborns) had pathologic arrhythmia.

In our patients we observed most frequently the occurrence of tachyarrhythmia (48 %). Its incidence was the highest among preterm infants: 18/34 = 53 % against 10/24 % in full term neonates. 31 % of our patients had extrasystolia. Bradycardia was observed in 21 %. Its incidence was substantially lower (12 %) in the preterm group.

The number of arrhythmic patients (58) observed by us is, however, not high enough to allow to draw final conclusion. Pathologic arrhythmia led to congestive heart failure in 60 %, thus, in a fairly high proportion of the patients. We observed the symptoms of heart failure more frequently among preterm (65 %) than among full-term (54 %) infants.

Antiarrhythmic treatment had to be applied in 76 % of the patients with pathologic rhythm disturbance. We have not found significant dikfference between preterm and full-term newborns in this group.

In the treatment of the patients we had fairly good result with digoxin (in 9 of 16 cases) and with beta blocking agents (oxprenolol = Trasicor was successful in 14 from 16 cases) /4/.

In the case if Wolff-Parkinson-White syndrome was supposed or proved to be in the background of the disorder we abstained from the administration of digoxin. We used Verapamil in one occasion only. Recently, attention has repeatedly been drawn to the risks (asystole) of the intravenous administration of this drug, moreover, according to Garson /7/ its administration in neonatal age is even contraindicated.

We have obtained remarkably good results in ventricular arrhythmias with Phenytoin (Epanutin, Diphedan). We obtained prompt favourable response in ventricular tachycardia (3 patients), polytopic ventricular extrasystole (4 patients), and in ventricular + atrial polytopic extrasystole (1 patient). From the patients diagnosed as having arrhythmia in neonatal age, 51 appeared at the age of 3 years for control examination and in 9 of them (17.6 %) was the presence of rhythm disturbance still observed (Tables I-IV). It was found in almost identical proportion among preterm and full-term infants (19 % and 15 % respectively).

We have lost no patient because of arrhythmia. Deaths were caused by the severe basic disease (Table III-IV) in all cases. It can be stated that in case of adequate treatment pathologic arrhythmias appearing in neonates, endangering circulation or leading to congestive heart failure do not interfere with the patients' life expectations. By the age of 3 years 82 % of our 58 patients became symptom-free.

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